

## CLAIMS

What is claimed is:

1. An exposure system for patterning a plurality of electronic  
5 elements on a substrate comprising:  
a measurement device for optically measuring an existing geometric  
pattern on an  $n^{\text{th}}$  layer of said substrate;  
a computing device, coupled to said measurement device, for calculating  
a correction between said existing geometric pattern and an expected pattern  
10 for said  $n^{\text{th}}$  layer;  
an image transformation component, coupled to said computing device,  
for performing an image transformation on a pattern for an  $(n+1)^{\text{th}}$  layer of said  
substrate, based on said correction, to generate a corrected pattern; and  
a writing component, coupled to said image transformation component,  
15 for writing said corrected pattern onto said  $(n+1)^{\text{th}}$  layer using a programmable  
digital mask system.
2. The system as described in Claim 1 wherein said writing  
component comprises a radiation source.  
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3. The system as described in Claim 2 further comprising an optical  
system coupled to said writing component for guiding radiation from said  
radiation source to said programmable digital mask system and from said  
programmable digital mask system to said substrate.

4. The system as described in Claim 3 wherein said radiation source comprises a pulsed laser source utilizing inter-pulse intervals.

5. The system as described in Claim 3 wherein said radiation source  
5 is infrared light.

6. The system as described in Claim 3 wherein said radiation source is ultraviolet light.

10 7. The system as described in Claim 3 wherein said radiation source is x-ray.

8. The system as described in Claim 1 wherein said measurement device is an optical measurement device.

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9. The system as described in Claim 1 wherein said existing geometric pattern comprises a plurality of alignment marks.

10. The system as described in Claim 1 wherein said substrate is a  
20 deformable flexible substrate.

11. The system as described in Claim 1 wherein said substrate is plastic.

12. The system as described in Claim 1 wherein said substrate is metal.

5 13. The system as described in Claim 1 wherein said substrate is paper.

14. The system as described in Claim 1 wherein said substrate is glass.

10 15. The system as described in Claim 1 wherein said correction is made by a linear coordinate transform.

16. The system as described in Claim 1 wherein said correction is made by a non-linear spline function.

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17. The system as described in Claim 1 wherein said image transformation is performed locally for at least one segment of an electronic module.

20 18. The system as described in Claim 1 wherein said image transformation is performed globally for an array of segments comprising an electronic module.

25 19. The system as described in Claim 1 wherein said programmable digital mask system comprises an array of digital micro-mirror devices.

20. A system for patterning a plurality of electronic elements on a deformable substrate comprising:

a radiation source;

5 a programmable digital mask;

a detector for measuring an existing geometric pattern on an  $n^{\text{th}}$  layer of said deformable substrate; and

a control system for controlling said programmable digital mask and for implementing a method of patterning comprising:

10 a) calculating a correction between said existing geometric pattern and an expected pattern for said  $n^{\text{th}}$  layer;

b) performing an image transformation on a pattern for an  $(n+1)^{\text{th}}$  layer based on said correction to generate a corrected pattern; and

15 c) controlling the writing of said corrected pattern onto said  $(n+1)^{\text{th}}$  layer using said programmable digital mask and said radiation source.

21. The system as described in Claim 20 further comprising an optical system coupled to said control system for guiding radiation from said radiation source to said programmable digital mask and from said programmable digital mask to said deformable substrate, said optical system controlled by said control system.

22. The system as described in Claim 20 wherein said radiation source comprises a pulsed laser source using inter-pulse intervals.

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23. The system as described in Claim 20 wherein said radiation source is infrared light.

24. The system as described in Claim 20 wherein said radiation  
5 source is ultraviolet light.

25. The system as described in Claim 20 wherein said radiation source is x-ray.

10 26. The system as described in Claim 20 wherein said existing geometric pattern comprises a plurality of alignment marks.

27. The system as described in Claim 20 wherein said existing geometric pattern comprises a plurality of electronic component features  
15 having a pitch of between 1-10 microns.

28. The system as described in Claim 20 wherein said deformable substrate is plastic.

20 29. The system as described in Claim 20 wherein said deformable substrate is metal.

30. The system as described in Claim 20 wherein said deformable substrate is paper.

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31. The system as described in Claim 20 wherein said deformable substrate is glass.

32. The system as described in Claim 20 wherein said correction is  
5 made by a linear coordinate transform.

33. The system as described in Claim 20 wherein said correction is made by a non-linear spline function.

10 34. The system as described in Claim 20 wherein said programmable digital mask system comprises an array of digital micro-mirror devices.

35. The system as described in Claim 20 wherein said image transformation is performed locally for at least one segment of an electronic  
15 module.

36. The system as described in Claim 20 wherein said image transformation is performed globally for an array of segments comprising an electronic module.

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37. An exposure system for patterning a substrate comprising:  
an optical system comprising a radiation source and a programmable digital mask, said optical system for exposing an image of said programmable digital mask onto said substrate;

an optical measurement device for optically measuring an existing geometric pattern on an  $n^{\text{th}}$  layer of said substrate;

a computing device, coupled to said optical measurement device, for calculating a correction between said existing geometric pattern and an expected pattern for said  $n^{\text{th}}$  layer;

an image transformation component for performing an image transformation on an electronic pattern for an  $(n+1)^{\text{th}}$  layer, based on said correction, to generate an electronic corrected pattern; and

wherein said optical system is used to write said corrected pattern onto said  $(n+1)^{\text{th}}$  layer.

38. The system as described in Claim 37 wherein said radiation source comprises a pulsed laser source having inter-pulse intervals.

39. The system as described in Claim 37 wherein said radiation source is infrared light.

40. The system as described in Claim 37 wherein said radiation source is ultraviolet light.

41. The system as described in Claim 37 wherein said radiation source is x-ray.

42. The system as described in Claim 37 wherein said existing geometric pattern comprises a plurality of alignment marks.

43. The system as described in Claim 37 wherein said existing geometric pattern comprises a plurality of electronic component features having a pitch of 1-10 microns.

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44. The system as described in Claim 37 wherein said substrate is deformable and is plastic.

45. The system as described in Claim 37 wherein said substrate is deformable and is metal.

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46. The system as described in Claim 37 wherein said substrate is deformable and is paper.

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47. The system as described in Claim 37 wherein said substrate is deformable and is glass.

48. The system as described in Claim 37 wherein said correction is made via a linear coordinate transform.

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49. The system as described in Claim 37 wherein said correction is made via a non-linear spline function.

50. The system as described in Claim 37 wherein said programmable digital mask comprises an array of digital micro-mirror devices.

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51. The system as described in Claim 37 wherein said image transformation is performed locally for at least one segment of an electronic module.

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52. The system as described in Claim 37 wherein said image transformation is performed globally for an array of segments comprising an electronic module.

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53. An electronic module comprising a multilayered pattern of components written on a deformable substrate by a method comprising:

optically measuring a geometric pattern on said deformable substrate, said geometric pattern written on an  $n^{\text{th}}$  layer of said substrate;

calculating a correction between said geometric pattern and an expected pattern for said  $n^{\text{th}}$  layer;

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performing an image transformation on a pattern of an  $(n+1)^{\text{th}}$  layer based on said correction to generate a corrected pattern; and

writing said corrected pattern onto said  $(n+1)^{\text{th}}$  layer using a digital mask system.

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54. The electronic module of Claim 53 wherein said correction is via a linear coordinate transform.

55. The electronic module of Claim 53 wherein said correction is via a non-linear spline function.

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